DETERMINANTS OF CHILD MORTALITY IN KENYA

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A research project submitted in partial fulfillment of the requirements for the award of degree of Master of Arts in Economics in the School of Economics, University of Nairobi.

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DECLARATION

This research project is my original work and has not been presented for a degree award in any other university.

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DEDICATION

I dedicate this work to my loving family for their support throughout my studies. To my husband Ken, thank you for your love and support, you truly helped me.

To my little ones Hope and Hawi, I know you are too young to comprehend this, you motivated my study area. May God grant you a long healthy life.

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AIDS	Acquired Immunodeficiency syndrome
DHS	Demographic and Health Survey
HIV	Human Immunodeficiency Virus
IMCI	Integrated Management of Childhood Illnesses
KDHS	Kenya Demographic Health Survey
KNBS	Kenya National Bureau of Statistics
KSPA	Kenya Service Provision Assessment Survey
LOGIT	Logistic Regression Model
MDG	Millennium Development Goals
NFHS	National Family Health Survey
SSA	Sub-Saharan Africa
SRS	Sample Registration System
UN	United Nations
WHO	World Health Organization

ABSTRACT

The study used data from Kenya's 2014/15 demographic Health Survey in reassessing the major determinants of child mortality in Kenya. Different logit estimations were run in order to evaluate the independent effect of each variable (maternal, environmental, and demographic) on child mortality. The result shows that maternal age, wealth status of the household, child's birth size, mother's education and mother's religion are major determinants. Appropriate policies that aim at educating and empowering women are recommended in order to reduce the overall child mortality rates.

CHAPTER 1: INTRODUCTION

1.1. Background

According to WHO (1948), health is defined as a state of complete physical, mental and social wellbeing and not merely the absence of disease. Pritchett and Summers (1996) highlights that wealthier nations are healthier nations; meaning that wealth matters a lot for health as far as the development of the nation is concerned. In addition, the WHO declaration of Alma-Ata (1978) captures health as a basic human right and that it is fundamental for sustained economic and social well-being of a country. This is in line with achieving of economic goals in the Kenya Vision 2030 (RoK, 2007).[1]

The health status of a country can be measured by the level of various indicators[2]. These health indicators have been improving globally. However, these indicators are still poor in developing countries compared to similar indicators in developed countries. For example, life expectancy for women in Sub Saharan countries in 2014 was 63 years on average compared to 82 years in developed nations. Similarly, infant mortality rates for the developed nations was on average of 5 deaths per 1000 live births while for Sub Saharan countries was on average of 64 deaths per 1000 live births (PRB, 2014).

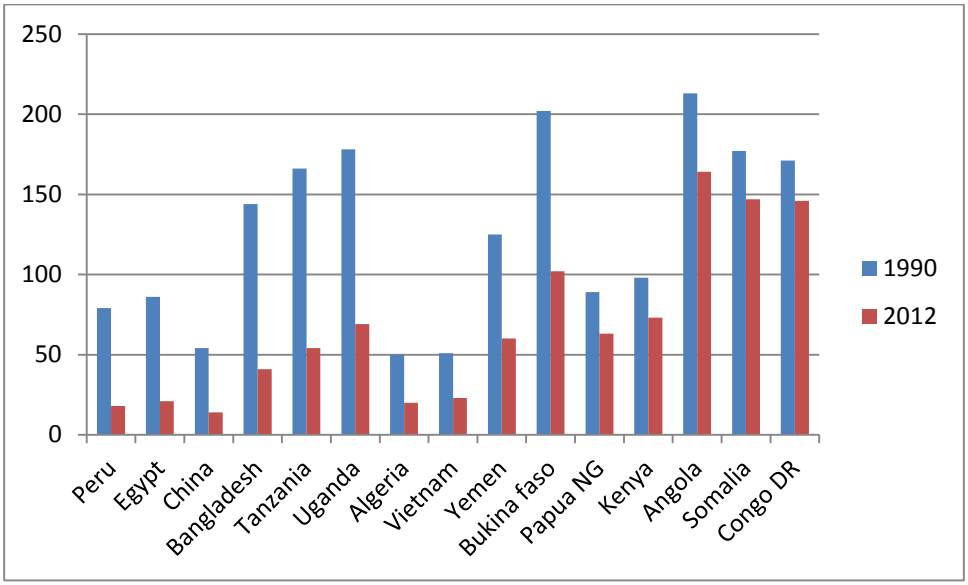
In this paper, we seek to establish child mortality determinants. Globally, many countries made significant progress in reducing child mortality reduction. For instance, in Figure 1.1, Bangladesh reduced child mortality deaths from 144 per 1000 live births to 41. It was reduced by72 percent, in Peru, while in Egypt, China and Tanzania over 66 percent reduction in child mortality has been achieved. Uganda, Algeria, Vietnam, Yemen and Burkina Faso have so far achieved between 33-65 percent reductions. Countries that have achieved less than 33 percent reduction include Kenya, Angola, Somalia and

[1] Policy plan by the Kenyan government to be a middle income economy by the year 2030

[2] Life expectancy, mortality rate and morbidity rate (manifestation of disease)

Democratic republic of Congo. Child mortality rate still remain high at 25 percent in SSA. It is estimated that nearly half of the deaths reported globally occurred in SSA. The most affected countries by the under-five mortality include India (22 %), Nigeria (13 %), Democratic Republic of Congo, Pakistan and China (UNICEF, 2014).

Figure 1:1 Overall reductions in child mortality per 1000 live births

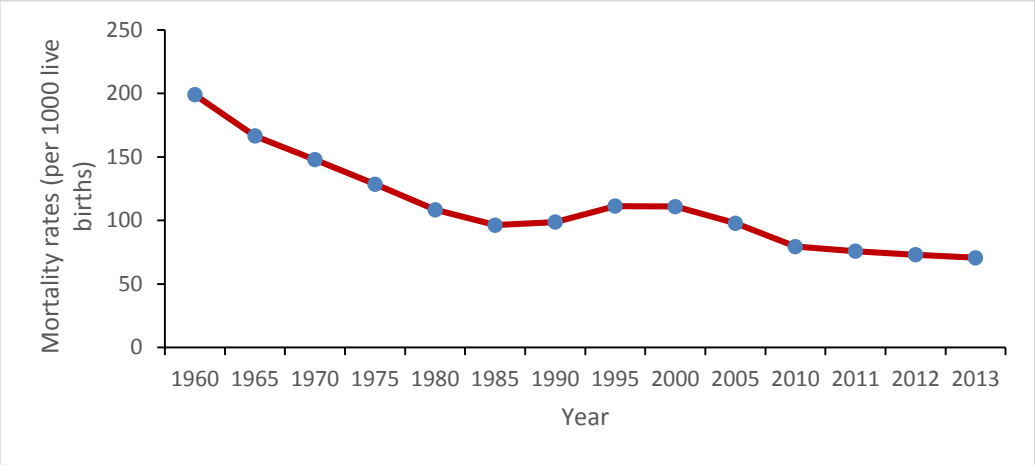


Source: Population Reference Bureau (2014)

Figure 1.2 shows child mortality was about 63 percent in 1960's. This was followed by a steady decline throughout the years before rising in 1995. The decline was attributed to economic growth that Kenya achieved in addition to increased childhood immunization programs and malaria prevention strategies. The reversed trend from 1995 was attributed to upsurge of HIV/AIDS pandemic (Hill et al., 2001). From 2008, child mortality rates have been declining steadily. Though declining, it has only moved from 40% to 22% between 2008 and 2013 which is below the minimum MDG[3] target of 22 deaths per 1000 live births.

[3] Currently Sustainable Development Goals (SDGs)

Figure 1.2: Child mortality rates in Kenya



Source: World development Indicators database (2015)

In Kenya, the first Health framework[4] stipulates various intervention strategies to improve health status. The sector has witnessed increased government expenditure on health including introduction of user fee exemptions for specific health services that captures treatment of children aged five years. Maternity services in both dispensaries and health centres, TB treatment and immunization services in public health facilities have also been exempted from charging of any fee. Other intervention targeting infants include the Malezi bora strategy[5] (RoK, 2010).

Despite the implementation of these policies, we have not achieved the fourth MDG target in Kenya. Even though the exact cause of death in children is lacking, it is presumed that the causes are pneumonia, malaria, measles and diarrhea. Child Mortality rates have also been attributed to increased poverty and child malnutrition (Ikamari, 2004). Child mortality shows a slow response in performance as shown in Table 1.1. For instance, according to the 2014 Kenya Demographic and Health Survey data, infant mortality dropped to 39 deaths per 1,000 in the 2013-14 survey compared to the 2008 survey (52 deaths per 1,000). Correspondingly, under-five mortality rate declined to 52 deaths per 1,000 live

[4] (1994-2010) lays out elements of sound health care delivery system to highest health standards that responds to the need of the population

[5] Focus on child immunization, deworming, Vitamin A supplements, treatment of childhood illness, ownership and use of treared mosquito nets

births in 2014 from 74 in 2008. Most deprived children are from the poor families, from certain deprived counties and from urban informal settlement.

Table 1.1: Trends in early childhood mortality rates in *Kenya: 1984-2002*

Year	Infant mortality	Under five mortality
1989	60	89
1993	62	96
1998	74	112
2003	78	114
2008	52	74
2014	39	52

Source: *Kenya demographic health survey, 2014.*

Existing literature on child health have outlined factors associated with child mortality. These studies focused on specific determinants of choice. For instance, Elmahdi (2008) considered socioeconomic determinants[6] to be more important in determining infant mortality. Mutunga (2004) examined infant and child mortality relationship with household's socioeconomic and environmental[7] characteristics and found both as having significant impact on child mortality. Wamae et al. (2009) assessed the health practices in the management of child illnesses in health centers and concluded health providers do not conduct full investigation and counseling of sick children and thus are responsible for the rising trends on child mortality.

In Jordan, Kaldewei and Pitterle (2011) argue that behavioral factors such as smoking, breast feeding and birth spacing bears weight in explaining infant mortality. Linnan et al (2012) attributes child mortality to drowning in Asia while Bello and Joseph (2014) attributes poverty and malaria as a major cause of child and infant mortality in Nigeria. Factors explaining child mortality include; age of the mother, low socioeconomic and

[6] Mothers education, place of residence, labour market status of the mother
[7] Access to sanitization, source of water, source of energy type of dwelling

cultural status, education status of the mother, environmental conditions, access to clean water and sanitization facilities (Osita et al, 2015).

Maternal education plays a great role in child mortality reduction. Caldwel (1979) indicates that educated mothers utilize health facilities and available resources to improve their own health and that of the child. Education also results into a wide range of favorable behaviours[8] that are child care connected and play a key role in child health improvement.

Literature on child mortality reveal that several variables affect child mortality however, given the change in awareness levels and facilities day by day, child mortality predictors are also changing over time. Hence continued research using current data set is necessary to identify population segments that require strengthened programs so as to achieve the MDG goal of reducing overall child mortality. The focus of this paper therefore is on the determinants of child mortality in Kenya.

Economists are concerned with health and mortality studies since it focuses on the allocation of best amounts of medical care that is most efficient. For instance, how does additional cost of medical care provision outweigh benefits of improved health? This will eventually depend on varied choices; preference, severity and the available medical resources.

[8] Educated mothers do utilize health facilities, better health seeking practice; utilize resources to improve health of their children

1.2 Statement of the Problem

For decades, child mortality has been a social and economic problem internationally. Governments have succeeded in reducing child mortality by implementing health policies that aim at improving children's health and increase in health expenditures over the years (RoK, 2010). A decline in child mortality has been witnessed in Kenya over the years as shown in Figure 1.2. However, the decline rate is rather slow; achieving the two thirds reduction in child mortality by the year 2015 may not be a reality. Several studies; (Osita et al, (2015); Omolo, (2014); Mwangi and Muriithi, (2015) on causes of child mortality in Kenya show that poverty, environmental conditions and social characteristics[9] affect child mortality.

Biological factors, maternal factors[10], environmental factors[11], injury[12] and health seeking behaviors[13] have been demonstrated as major determinants. These factors drive the key interest of this study. Literature reveals that child mortality reduction rate is quite low to derive the fourth MDG goal in Kenya. Therefore there is need to establish the factors determining child mortality using the current data set which will be more appropriate to consider in assessing the impacts of current government interventions on child mortality. This study proposes to assess the effects of maternal, environmental and demographic variables on child mortality. A lot of researches have used previous data set (KDHS 2008) hence, it is critical to assess and reevaluate these determinants.

There is need to apply logistic regression model in estimating each independent effect of each variable whilst controlling others as opposed to analysis by means of cross-tabulation. In cross tabulation analysis, association between child mortality through several varied characteristics is shown. nevertheless, it fails to tackle the predictors of mortality fully. This is because it ignores other covariates. In conclusion, a deeper

[9] Wealth status, place of residence
[10] Age of the mother, birth interval, birth order, sex of the child
[11] Flooring material, access to water and sanitation
[12] Can be intentional or unintentional for example burns, drowning
[13] Place of delivery, immunization

understanding these factors will help in identifying potential risk factors that are associated with child mortality. Therefore, appropriate guidance for policy formulation is achieved that will target the specific risk factors associated with child mortality.

1.3 Research questions

The study will address the following questions:

a) What are the maternal, environmental, and behavior factors effects on child mortality in Kenya?
b) What are the policy implications for the reduction of child mortality rate in Kenya?

1.4 Objectives of the study

The general objective of this study is to establish the determinants of child mortality in Kenya. The specific objectives include;

a) To examine the socioeconomic determinants of child mortality in Kenya.
b) To make policy recommendations towards reducing child mortality rate in Kenya.

1.5 Relevance of the study

The study will add to the existing literature on child mortality in Kenya. In addition, it will use recent demographic data, (KDHS 2014) which will be more appropriate to consider in assessing the impact of current government intervention on child mortality. Lastly, the study has been done at the initial stages and years of the implementation of the Kenya health policy plan 2010-2030 therefore policy recommendations given may be useful for the government in its effort of reducing child mortality.

CHAPTER 2: LITERATURE REVIEW

2:1 Introduction

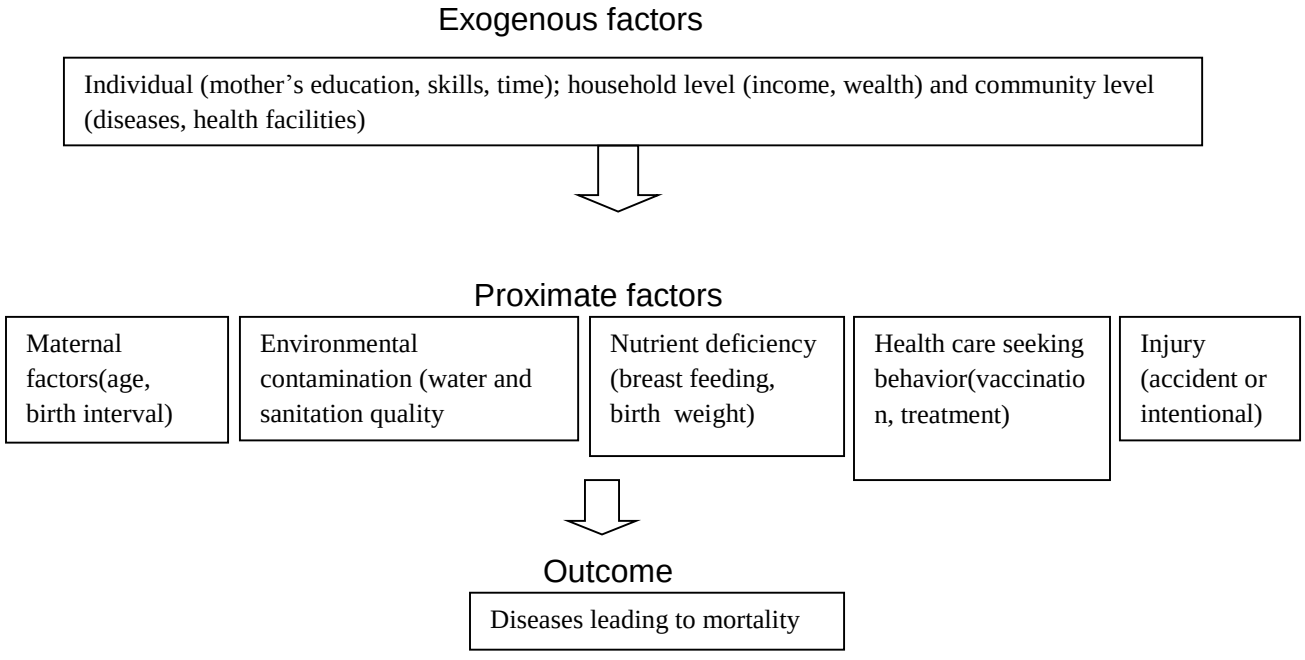
The section covers Mosley and Chen (1984) which forms the foundation theory, followed by empirical literature that demonstrate specific studies and related findings. Finally, an overview of section highlights the literature gaps.

2.2 Theoretical literature review

2.2.1 Mosley-Chen framework

Mosley and Chen (1984) position framework of child survival on the assumption that all social and economic factors affecting child mortality operate through a set of intermediate factors[14] . According to this framework, about 97 percent of children born are likely to survive until their fifth birthday. However, the influences of socioeconomic, biological and environmental factors are the driving forces behind reduction in survival probabilities.

Figure 2.1: Mosley-Chen theoretical framework:



Source: Adapted from Mosley and Chen (1984)

Figure 2.1 shows how the proximate determinants operate on dynamics of population's health. Maternal factors, nutrient deficiency, and environmental contamination and injury

[14] proximate or socioeconomic determinants

affect the rate at which healthy individuals shift towards sickness. Personal illness control[15] factor affects the illness and recovery rate through prevention and treatment respectively. The state of sickness may lead to recovery, growth faltering or eventual death (dependent variable).

Maternal factors (age, birth order and birth interval), personal illness control environmental contamination, nutrient deficiency and injury influence pregnancy outcome and child health. Children born in good environmental condition and well taken care of are expected to survive compared to children born in deplorable conditions.

At individual level, household's members' productivity is determined by the skills which are captured by the level of education, health and time. For fathers, skills usually relates strongly with occupation and income. Fathers' education strongly determines household assets and strongly influences preference and attitude in choosing goods to be consumed which include child care services. Their effect is more considerable for child survival when educated fathers are married to mothers who are less educated (Mosley and Chen, 1984). Conversely, mothers education can affect child survival by influencing choice and increased skills of healthcare practice that are related to contraception, hygiene, nutrition, treatment of diseases and preventive care (Caldwel,1979).

Child health and mortality consequences depend generally on the economic circumstance of the household. For example, mothers' outside work for poor families may lead to neglect of a child while wealthy families may hire a skilled nursemaid. Other household variables like income and wealth affects the availability of goods and services and assets owned by members of the household.

Housing size, ventilation and crowding matters for child survival. Sanitation requires that construction materials can be cleaned and separate rooms assigned for daily chores like cooking, bathing, toilets, sleeping, of food and water storage among others. Proper

[15] Personal preventive measures; medical treatment

cooking of food requires adequate supply of fuel too. In addition, physical infrastructure influences health through the relative price, services and information (Mosley and Chen, 1984).

This framework of studying child mortality provides foundation for formulation of health policies since it integrates both biological and social determinants of mortality. For the purpose of this study, we will base our analysis on the Mosley and Chen (1984) theoretical framework. It guides in the choice of dependent and independent variables based on the assumption that proximate determinants (social, economic, demographic and medical determinants), affect the survival probability of children through a set of biological mechanism.

2.3 Empirical Literature Review

This section provides analysis of specific studies done with regards to child mortality; basing on the proximate determinants and backed with evidences and related findings.

2.3.1 Socioeconomic determinants of child mortality

Child survival depends on a number of social, cultural, economic and environmental conditions. It has emerged from several studies (Osita et al., 2015; Omolo, 2014 and ; Mwangi et al. 2015) that mothers' education, personal hygiene, place of residence, toilet facilities, water supply, household economic status, illness, accidents and expenditure on health do influence child survival. The behaviour and knowledge of adults caring for children is critical in determining child's survival when they become ill.

Association has been found between maternal education and survival of the child. Caldwell (1979) with reference to Nigeria concluded that higher education lowered the rate of infant mortality through factors like hospital delivery, increased ante natal care for pregnant mothers and changing traditional family relationships. His argument is that changing feeding practises and care practices leads to better health seeking which is driven through mother's education. Hobcraft (1993) argues that educated women marry

and enter into motherhood later in life; this makes them have fewer children. Furthermore, educated women utilize prenatal care services and they subject their children to immunization. Hospital deliveries increased with the education level of an expectant mother and that of her spouse (Brals et al, 2013). Mothers without education had a higher risk of child mortality (Osita et al, 2015). Mother's education effect on infant and child mortality was found to be significant in several other studies for example (Hosseinpoor, 2005; Fayehun, 2010; Mutunga, 2004; Uddin, Hossain & Ullah, 2009).

Maternal education can also be used as a proxy for other household characteristics. Medrano et al. (2000) used mother's education and Kovsted et al. (2003) used mother's religion as a measure of health knowledge and they concluded that with increased knowledge, a child's good health is achieved. Nevertheless mother's education has inverse impact on child's health. Beenstock and Sturdy (1990) found out that maternal education had a weaker effect on the child's survival in Sub-Saharan Africa. Hill et al. (2001) made a conclusion that HIV epidemic was the most probable cause of increased child mortality and not the socioeconomic or demographic factors.

Place of residence greatly influences child mortality. Mwangi and Murithi (2015) found out that infants born in Coast, Eastern, Central, Nairobi and Rift valley provinces have lower risk of dying while those born in Nyanza, North Eastern and Western provinces had higher rates of mortality. Kabubo-Mariara et al. (2012) while modifying the Mosley and Chen (1984) framework in modelling child survival found out that rural child have been more subjected to poverty thus more likely to die than children living in urban areas. Mwangi and Murithi (2015) argue that infants born to mothers residing in rural areas have high mortality rates due to unavailability of adequate health facilities. This is similar to Osita et al (2015) findings. Therefore, improvement in child living conditions in rural areas is necessary in reducing child mortality.

Labour market status was found to play significant role in child mortality. Mwangi and Murrithi (2015) applying Cox hazard model[16] in determining child mortality in Kenya, found out that infants born to mothers whose occupation is sales agent had higher risk of dying compared to infants born to mothers who are managers or teachers. Uddin, Hossain and Ullah (2009) found out that mother's occupation had no significant effect on child's mortality. However, father's occupation greatly determined child mortality. High mortality levels were witnessed to fathers whose main occupation was agriculture as compared to fathers who were service holders.

Poverty, diseases, injury and malnutrition have been put forward as major determinants of child mortality. Elmahdi (2008); Kaldawei and Pitterle (2011); concluded that breastfeeding is key determinant of child's mortality. The poor and the very rich are also found to have high mortality levels. This is because the richest mothers are very busy and have no time for babies while the poor can't afford good nutrition and medical attention for both the mother and the child Mwangi and Murithi (2015).Other studies have highlighted poverty as a major determinant of child mortality; (Radolfo, Wall & Pearson, 2000; Kabubo-Mariara et al, 2012; Omolo, 2015; Osita et al,2015).

According to Jones et al. (2006), diseases (diarrhoea, Pneumonia and tetanus), premature deliveries, and bacterial infections and under nutrition were the major causes of child mortality in India. Osita et al (2015) found that having caesarean section deliveries increases risks of child mortality. Omolo (2014) argues that children delivered in public facilities had a lower mortality risk than those born in private hospitals. This contradicts the findings by Mwangi and Murithi (2015) that infants born at private hospitals have a lower risk of mortality. This is because private hospitals have better facilities, health workers and drugs as compared to public hospitals.

[16] Used in survival analysis to assess the importance of various covariates in the survival times of individuals through the hazard function

2.3.2 Proximate maternal factors

Numerous studies have found strong relationship between child survival and maternal factors. These Studies have provided an evidence of a reverse pattern of the association between mothers' age at birth and infant mortality, with teenage and older mothers having higher risks of child loss (Pebley, 1991; Ngigi, 2013; Hobcraft, 1993;Mcdonald & Rutstein, 1985; Brals et al, 2013).Very young mothers are not fully mature biologically and their inexperience in taking proper care of the child increases mortality. Conversely, older women experience pregnancy related complications due to age. The study by Pandey et al. (1998) in Iran further found a U shaped relationship linking birth order and maternal age at birth with infant mortality. Thus when age increases from teenage to matured mother, mortality falls and it rises as one move to elderly mother.

Birth interval of less than two years poses risk of child mortality (Da vanzo et al, 2004; Madise 2003). While firstborns and children of higher birth order (4and above) have high mortality risks (Osita et al, 2015). Children with low birth weight have higher mortality risks while child's gender has shown varied effects. Claeson et al (2000) observed that in India, boy child is prevalent to immunization than the girl child. This is due to preference for a son than a daughter; hence girls have a higher risk of dying before their fifth birthday by a margin of 30%. Their findings contradict that of United Nations (UN) Secretariat (1988) that carried out a study on sex differentials on life expectancy and mortality in less developed countries and found out that male children had higher probability of dying than the female infants.

2.3.3 Proximate environmental factors

Hosseinpoor et al. (2005) recommended that additional interventions to be done in regards to the environment and sanitation in order to reduce infant mortality. Alves and Belluzzo (2005) basing their study in Brazil found out that mortality rates are determined by hygiene at both the household and environment. In Several studies, household's socioeconomic status has been considered in terms of their drinking water source, sanitation, source of cooking fuel and income level. The socioeconomic factors effect on

mortality is through environmental hazards, maternal factors, injury and nutritional status (Mosley and Chen, 1984). Fayehun (2010) found out that there is a significant relationships between the environment of the household and child's survival in Sub-Saharan countries. Some of these differences in childhood mortality could be accounted and explained by levels environmental health hazards of household's are exposed to. In addition access to piped water, sanitation and availability of toilets have been found to reduce risks of mortality (Mwangi and Murithi, 2015; Omolo, 2014)

2.3.4 Health seeking behavior

In seeking health care services, mother's behaviour is considered as either a preventive or curative treatment is necessary. Boone and Zhan (2006) attribute this behaviour to knowledgeable parents. Uddin, Hossain and Ullah (2009) realized that child mortality was higher for mothers who did not attend antenatal visits in Bangladesh. Kaldawei and Pitterle (2011) argue that immunization coverage is associated with lower child mortality. Omolo (2014) found out that mother's place of delivery without the influence of socioeconomic factors is insignificant.

2. 4 Methodological consideration and data choices

In studying child survival, a reduced-form demand equation for health can be used. The model is based on the utility theory where households choose an alternative from a set of alternatives in order to maximize their utility (Rosenzweig and Schultz, 1983).

Secondary data mainly National Family Health Survey (NFHS) data, Demographic and Health Survey (DHS), Census data and Sample Registration System (SRS) was used in most of the studies. Some used surveys (Omolo, 2014; Bello and Joseph 2014). Other researchers opted to use data from several surveys to have a clear understanding of the health outcome for example (osita et al, 2015;Kabubo-Mariara et al, 2012) further, some studies used a particular country's data while others used data from several countries. In addition, where data on income levels were not collected, it was proxied by wealth and particular analysis of the data was done using the most suitable methodology based on the expected findings. For instance some of the studies used survival time analysis

(Kabubo-Mariara et al, 2012),Cox proportional hazard model, Logistic and Probit regression model were also used in cases where the dependent variable was a binary choice variable (Hosseinpoor et al, 2005). Most of the results and findings were presented in tables and graphs.

In this paper logistic regression model is applied in estimating each independent effect of each variable under study while controlling others as opposed to using cross-tabulation analysis while adopting the Mosley and Chen (1984) model in choosing both the dependent and the independent variables. cross tabulation analysis shows the relationship between mortality by several varied features.. Nonetheless, it fails to tackle the predictors of mortality fully. This is because it ignores other covariates.

In conclusion therefore, there are several factors that have been argued and put forward to be the main determinants of child mortality. The choice of variables used in the present study will be guided by the availability of data.

2.5 An overview of Literature

The determinants of child mortality from literature reviewed are classified as socioeconomic, demographic and environmental factors. Similarly, health services and behaviour that promote and increase stock of health (e.g tetanus injection for pregnant mothers, higher education, to clean water access and sanitation) have significant impact on child's survival hence associated with improved health status of the child.

Injury causes leading to child mortality mentioned by Mosley and Chen (1984) have not been fully explored in Kenya. Drowning has been studied as a major factor contributing to child mortality in Asia (Kaldewei & Pitterle, 2011). Lack of data has been a major limitation for researches to cover this aspect of child mortality. This study will use current data set to reassess the determinants of child mortality in Kenya**.**

CHAPTER 3: METHODOLOGY

3.1. Introduction

The chapter presents methods of analysis and describes the data that will be used.

3.2. Conceptual framework

Rosenzweig and Schultz (1983), argues that to study child survival, a reduced-form demand equation for health can be used. This equation comprises the health production function and input-demand function for health. The model is based on the utility theory where households choose an alternative from a set of alternatives in order to maximize their utility. The utility function for the household can be given as:

$U = f(X, Y, H)$……... (1)

Where: X is a consumption good yielding utility however it has no direct effect on health[17]; Y is a health related good that affects health[18] and H is the health status of the child

According to Schultz (1984), health production function of a child can be given as a linear function;

$H = f(Y, I, K, \varepsilon)$…… (2)

Where; Y is the proximate biological inputs to child health[19]; I is a child health input[20] ; K is the health knowledge possessed by the household and ε is the child health endowment due to genetic or environmental conditions.

The proximate inputs Y are chosen by the households in a manner to reduce the health outcome i.e mortality. These inputs depend on the child health endowment (ε), maternal/household preferences (PR), market prices and household physical environmental constraint (P) and household wealth (L). Therefore, we maximize the utility function (1) given the production function (2) subject to household's budget constraint which is given as:

$L = P_X + P_Y + P_I$…….. (3)

[17] Mother's education, place of birth, birth interval, mothers age, number of kids in the family, employment status of the parents
[18] Such as consumption of food and medication
[19] Includes immunization, cooking fuel, water and sanitation environment
[20] Curative and preventive medical care

Where; L is the household income; P_X is the price of the consumption good with no direct effect on health; P_Y is the price of the health related good; P_I is the price of the child specific health input

3.3. Empirical model

The study shall use logit model in the analysis of child mortality rates.

For a logit model, probability of reporting a child dying can be given as:

$Pr(Y=1=P_i$.....(8)

While the probability of a child not dying is given as:

$Pr(Y=0) =1-P_i$ .....(9)

The logit model follows the S-shaped or sigmoid distribution function given as:

$P_i=p(Y_i=1) =\frac{1}{1+e-(\beta 1+ \beta 2Xi)}$.....(10)

This can be re-written as;

$P_i=p(Y_i=1) = \frac{1}{1+e-Zi}$..... (11)

Where: $Z_{i=} \beta_1+\beta_2X_i$

Logistic distribution function is represented by this. As Z tends to infinity, e^{-z} approaches 0 and *p* tends to 1 but cannot exceed 1. On the other hand as Z tends to minus infinity, e^{-z} approaches infinity and *p* tends to 0 but cannot be below 0.

In this study, the probability of a child dying is given as:

$P_i=p(Y=1| x) =\frac{1}{1+e-(\beta 0+ \beta 1X)}$ .....(12)

Where, X represents a vector of independent variables and β is a vector of their respective coefficients.

Equation 12 can be re-written as:

$P_i=p(Y=1| x) = \frac{1}{1+e-Zi}$.....(13)

The probability therefore of a child not dying can thus be given as:

$(1-P_i)= p(Y=0| x) = \frac{1}{1+eZ}$.....(14)

We derive the logistic function model by taking the odds ratio which is a logit predictor. This is given as

$\frac{Pi}{1-Pi} = \frac{1+ezi}{1+e-zi}$ .....(15)

Taking the natural logarithm of the above equation gives the logistic model below

$Li = In \frac{Pi}{1-Pi} = Z_i$

Where $Z_i = \beta_0 + \beta_1 Ma + \beta_2 Me + \beta_3 Tor + \beta_4 Mre + \beta_5 Ms + \beta_6 Tn + \beta_7 G + \beta_8 Bo + \beta_9 Bsp + \beta_{10} Bsz + \beta_{11} L + \beta_{12} Scf + \beta_{13} Ats + \beta_{14} Atw + \beta_{15} Pod + \beta_{16} TTI$) which answers the general objective on determinants of child mortality.

3.4 Study variables

Study variables were selected based on the Mosley and Chen framework on the factors affecting child's survival in developing countries (Mosley and Chen, 1984). Other previous studies on child mortality played a major role in assessing major determinants of child mortality. The variables chosen are determined by data availability and comprised of place of residence (rural or urban), household income, maternal characteristics (religion, age, education level), child characteristics (gender, size, birthplace, birth order)

The model estimated is specified as:

C=f(Ma, Me, Mre, Ms, Tor, Tn, G, Bo, Bsp, Bsz, L, Scf, Ats, Atw, Pod, TTI) ……(7)

Table 3.1 Variable definitions and priori expectations

Variables	Measure	Priori expectation
Mother's age (Ma)	mother's age at the time of child birth measured as a discrete variable with different age groups	Very young and very old women are likely to have high child mortality
Mother's education (Me)	The level of education attained by the mother captured as no education, primary , secondary or higher education	Higher education level is expected to be associated with low mortality levels
Mother's religion (Mre)	Mother's religion which was categorized as Christian, Muslim or nonreligious.	Mother's with religious background will be expected to have lower child mortality risk.
Marital status of the mother (Ms)	Mother's marital status; captured as either married or not married	Married women are expected to have lower risk of child mortality.
Number of children under 5 years (Tn)	The number of live children a mother has had for the past five years.	Household with more than 2 children under the age of 5 years are expected to have high child mortality rate
Gender (G)	Sex of the child which is either male or female	Girls are expected to have lower mortality risk than boys.
Birth order (Bo)	The child's birth order in the family, it is captured as first, second, third and above 3.	Mortality is expected to be high at first birth and above 3 birth order
Birth spacing (Bs)	The birth spacing between children captured as less than 24 months or more than 24months	Birth spacing of 24months or more is expected to decrease child mortality
Birth size (Bsz)	Refers to the size of the baby at birth as reported by the mother. It is captured as small, very small, average, large or very large babies	Small size and very large babies are expected to be associated with high mortality risks
Residence type (Tor)	Household's residence whether in rural or in urban area.	Urban residents are expected to have low mortality risks as compared to rural areas
Wealth of the Household (L)	The households are categorized as poor, middle or rich households	Children born from poor families are expected to have high mortality risks
Cooking fuel Source (Scf)	Source of cooking fuel used by households. It is categorized as use of electricity, LPG, kerosene, wood, charcoal or dung.	Clean cooking fuel is associated with low mortality risks.

Access to sanitation (Ats)	Availability of sanitation services in households, it is captured as no facility, flush toilet, pit toilet and ventilated improved toilet	Clean human waste disposal availability reduces mortality risks
Access to water (Atw)	Source of drinking water for households. Whether piped, well, rainwater, river water	clean drinking water is expected to improve child survival
Delivery (Pod)	Place where child was born, either at the hospital or non hospital deliveries	Hospital delivery is expected to lower child mortality
Tetanus Toxoid injection (TTI)	Captures as whether mother received immunization or not.	Children whose mothers are immunized are expected to have lower mortality risks.

3.5 Diagnostic test

3.5.1 Likelihood Ratio (LR) test

This test will help asses if the model is correctly specified so as to obtain meaningful results. When the p-value for LR test is less than 0.05, then significant relationship between the independent variable(s) and the dependent variable, while if the p>0.05, then there is no significant relation between the stated variables.

3.5.2: Data source and analysis tool

The study used KDHS (2014) data from survey conducted by KNBS between the periods of March 2014 to May 2015. KDHS (2014) is a national representative survey of 32000 women aged between 15-49 years, serves as source of information on health and population for policy makers and for the entire research community.

Cross-tabulation analysis has been applied in testing linkage between child mortality, bio-demographic, socioeconomic and maternal health. This analysis shows relationship between mortality among several varied characteristics. Nevertheless, it fails to fully tackle mortality predictors since it ignores other covariates. In this study logistic approach is used in estimating the independent effect of each variable at the same time controlling others.

Before the analysis, various variables were regrouped. For example birth spacing was recorded into two; less than 24 months old and more than 24 months old, birth order recorded to 2-3, first order and above third order, access to sanitization, access to water and delivery place was also grouped accordingly.

Descriptive analysis was done and presented by mean, standard deviation and frequency to help understand the data. Logit model was then run using STATA statistical software and results presented and marginal effects interpreted, the betas will be showing elasticity's.

CHAPTER 4: RESULTS AND FINDINGS

4.1 Introduction

This chapter presents results and their discussions. The chapter begins with the demographic information of the respondents followed by analysis, presentations,

interpretation and discussions of research findings based on the respondents' demographic characteristics, and lastly the results of the logistic regression model.

4.2 Sample Description

The demographic information of the respondents was analyzed in terms place of residence, gender, mother's religion, marital status, birth order, birth spacing, access to water, access to sanitation, cooking fuel source, wealth of the household, cooking fuel source, delivery place, tetanus toxoid injection, residence of the respondent and the education level. Demographic characteristics gave a clear understanding of the respondents included in the study. The demographics were presented in terms of the frequencies in addition to measures of central tendencies for instance means and standard deviation.

The sample upon which this study is based included 31079 women. Majority (63%) of the respondents resided in the rural areas. From Table 4.1, nearly 85% are Christians while about 13.4% are Muslims. Slightly over a quarter of these women were never married while majority were married. The proportion of female babies born stood at 50.29% compared to male babies 49.71%. Slightly over half the babies born were of second or third birth order while first birth order stood at 29%. Majority of the children born had birth spacing of more than two years.

Table 4.1 Demographic, environmental and socioeconomic variables

Discrete variables	**Percentage**
Mothers religion	
Roman catholic	20.07

protestants	64.66
Muslim	13.40
Not religious	1.63
Other	0.24
Marital status	
Never in union	27.59
Married	61.25
Widowed	3.83
Divorced	2.32
separated	5.01
Gender of the child	
Male	49.71
Female	50.29
Birth order	
First order	29.59
2-3 order	52.09
Above third order	9.42
Birth spacing	
Less than 2years	19.01
More than 2years	80.99
Birth size	
Small	16.46
Average	58.04
Large	28.55
Type of residence	
Urban	37.37
Rural	62.63
Wealth of the household	
Poor	42.58
Middle	19.13

Rich	38.29
Cooking fuel source	
Electricity	0.30
LPG/ Natural gas	4.01
Biogas	0.25
Kerosene/Coal, lignite	5.01
Charcoal	0.02
Wood	21.09
Straw/shrubs/grass	69.02
Agricultural crops	0.60
	0.20
Access to sanitization	
No facility	26.02
Flush toilet	10.35
VIP	15.55
Pit latrine	48.03
Access to water	
Piped water	17.07
Tap water	12.15
Open well	39.24
Rain water	29.33
Other	0.31
Delivery place	
Home	40.30
Government Hospital	46.49
Private hospital	13.21
Tetanus toxoid injection	
Immunized	87.78
Not immunized	12.22

Source: own STATA computation using KDHS 2014 data

Majority of the women received the tetanus toxoid injection during pregnancy with only 12% who reportedly did not receive the injection. 40% of women further reported that they gave birth at home, at other people's homes or on their way to the hospital. 46 % gave birth at government hospital compared to only 13% who gave birth in private hospitals

Open wells were the main source of water to most of the mothers (39.24%) and almost half (48.03%) of the respondents used pit latrine. The findings further revealed that firewood was the main source of cooking fuel especially in the rural areas where it is easily accessible

4.2: Mortality Rates Status: KDHS, 2014

4.2.1: Regional distribution of child mortality

From Table 4.2 below, only 999 (7.1%) of the babies born died while 13082 (92.9%) were alive. Regionally, Nyanza region had the highest proportion (10.5%) of the babies born in that region who died. This was followed by Western region (9.0%), then the Coastal region (7.7%), Central region (7.5%), Nairobi (7.4%), Eastern region (6.3%), Rift Valley region (5.3%) and lastly the North Eastern region (4.8%). Nationwide, Rift Valley region had the highest number (226) of the babies that died which was 22.6% of the total number of the babies who died. This was followed closely by Nyanza region with 225 babies (22.5%), then the Eastern Region with 144 deaths (14.4%), Coastal Region with 130 deaths (13.0%), Western region with 124 deaths (12.4%), then the Central region with 88 deaths (8.8%), North Eastern region with 45 deaths (4.5%) and lastly Nairobi region with 17 deaths (1.7%).

Table 4.2: Child Mortality by Region

Region	Total live births (Numbers)	% of deaths (Mortality)

Central	1180	7.5
Coast	1695	7.7
Eastern	2279	6.3
Nairobi	229	7.4
North Eastern	930	4.8
Nyanza	2139	10.5
Rift valley	4258	5.3
Western	1371	9.0

Source: own STATA computation using KDHS 2014 data

A chi-test on the relationship between the mortality and regional distribution indicated a result of Pearson Chi-square of 76.976, likelihood ratio 74.535, df = 7, and p-value = 0.00, see table 4.3 below. Since the $p<0.05$, this indicated quite a significant relationship linking child mortality and the region where the child is born. Regions such as Nyanza, Western, and Coast were prone to higher mortality rates as compared to central, eastern, northeastern, rift valley and Nairobi.

4.2.2: Mortality Rates and Area of Residence

From Table 4.4 below, 7% of child mortality occured in both the urban and the rural areas. Majority of child deaths occured in rural areas, i.e 67.6% of the deaths occured in rural areas compared to only 32.4% that occured in urban areas.

Table 4.4: Cross tabulation on Mortality Rates and Area of Residence

Place of residence	Total live births (Numbers)	Total deaths	% of deaths (Mortality)
Rural	9922	675	67.6
Urban	4159	324	32.4

Total	14081	999	7.09

Source: own STATA computation using KDHS 2014 data

4.3 Logistic Regression

This was done to assess whether the model was correctly specified. The log likelihood estimation was given as-438.825 LR chi2(17) as 269.97 with prob>chi2=0.000 and pseudo R^2 as 0.4348. From the aforementioned results, Logistic regression model adopted for this study was correctly specified and therefore child mortality is explained best by variables included in the model.

Table 4.3 Logistic Regression estimations results

Variable	Coefficients	Marginal effects
Individual factors		
Mother's age	0.946 (1.47)	0.006 (1.39)
Less than three number of children	-7.526 (7.12) *	-0.513 (3.43) *
Not married	0.393 (0.61)	0.002 (0.69)
Has religion	-1.449 (1.69) ***	-0.036 (0.93) ***
Primary education	-1.724 (-2.15) **	-0.039 (-1.73) *
Secondary education	-1.652 (-1.75) ***	-0.059 (-1.02) *
Higher education	-0.064 (-0.02)	-0.001 (-0.02)
Household factors		
Rural residence	0.081 (0.1)	0.03(0.09)
Wealth _Middle	-0.785 (-1.32) **	-0.008 (-0.99) **
Wealth _Rich	0.573 (0.61)	0.01(0.63)
Source of water		
Public tap	-0.591 (-0.68)	-0.005 (-0.54)
Open well	0.918 (1.1)	0.006 (1.05)
River	1.151 (1.27)	0.006 (1.34)
Other water sources	-0.874 (-0.67)	-0.009 (-0.45)
Sanitation facilities		

Flush toilet	2.747 (1.5)	0.008 (2.17)
VIP	0.339 (0.44)	0.002 (0.5)
Pit Toilet	0.278 (0.43)	0.002 (0.43)
Source of cooking fuel		
LPG	-10.261 (-2.74) ***	-0.988 (-32.41) *
Coal	-11.117 (-4.62) *	-0.992 (-109.22)
Wood	-11.033 (-5.62) *	-0.975 (-27.23) *
Grass	-11.458 (-5.81)	-0.167 (-1.86)
Child factors		
Two- three birth order	-0.538 (-0.68)	-0.004 (-0.64)
Above three birth order	0.399 (0.39)	0.002 (0.39)
Average size at birth^	-1.166 (1.96) **	-0.083 (1.59) ***
Large/ very large size at birth	0.309 (0.51)	0.002 (0.53)
Female	0.561 (1.16)	0.004 (1.1)
More than 24 months birth spacing	0.815 (1.43)	0.007 (1.06)
Health services variable		
Non-hospital delivery	-0.681 (-1.26)	-0.004 (-1.16)
Not-immunized for TTI	-0.837 (-1.59)	-0.007 (-1.16)
constant	6.879	

Number of obs. = 3082: Iteration = 31: log likelihood = -438.825: LR chi2(31) = 269.97, Prob>chi2 = 0.000:

Pseudo R2 = 0.4348

,,*** Significant at the 1%, 5% and 10% level respectively.* Z statistics in parenthesis

The symbol (^) after the variable name represents discrete change of a dummy variable from 1 to 0

The objective of the study was to examine the socioeconomic determinants of child mortality in Kenya. The logistic model results shows that mother's religion, mother's age, mother's education level, household wealth status, total number of under five years children in a household, source of cooking fuel and infant's size at significantly explains

child mortality. An increase in the mother's age by one year reduces the probability of child death by almost 10 percent. This shows that as age increases mothers become more knowledgeable in child care hence the probability of child death is lowered.

Mothers with less than three children had a lower probability of child death by 51.3 percent as compared to those mothers who had more than two children. This can be attributed to education levels. Educated mothers prefer fewer children whom they are able to take proper care of thus reducing the probability of child death. The finding is per our earlier expectations where households with more than two children under the age of five years in a household were expected to have high child mortality.

Religion (Christianity, Muslim, and Hindu) had a 3.6 percent lower probability risk of child death as compared to mothers with no religion. This could be as a result of the various educational and support programs offered by churches in areas of health which could promote health knowledge. This are similar to those of (Kovsted et al. 2003)findings who using religion as a measure of mothers knowledge found that a mothers religion was an important factor in determining a child's health. However, contrasting findings were observed by Mutunga, (2004) and Anjali, (2001), who noted that religion had negative impact on child mortality.

Mothers who attained primary and secondary education had a 4 and 5 percent reduced probability of infant death respectively as compared to mothers with no education. This can be as a fact that with higher education, child mortality risk is lowered. Education is presumed to increase mother's knowledge with regards to child care, disease prevention, pregnancy care and general health. This is supported in literature as higher education was found to lower the rate of child mortality through factors like hospital delivery, increased ante natal care for pregnant mothers and changing traditional family relationships.

An increase in the household wealth from poor to middle lowers the probability of child's death by 0.8 percent. This can be attributed to education; educated mothers are more

likely to be categorized as middle class; this implies that with the increase in wealth and health knowledge, the risks associated with child mortality is lowered. These findings are similar to those of Kabubo-Mariara et al. (2012) and Fayehun (2010).

Clean cooking fuel source that is free from air pollution was expected to improve the status of health the child and thus reduce mortality levels. Thus, Use of LPG gas, coal and wood as cooking fuel source, lowered the probability of Child death by 99.4, 99.6 and 99.6 percent respectively relative to those using electricity. This can be explained through the fact that that the study sample (76 percent) was drawn largely from rural areas where wood is the main source of cooking fuel. The study contradicts other findings in the literature. This could imply that there exist differentials in both urban and rural households which could further explain the differences in mortality rates.

Child's birth weight is proxied by infant's size at birth (small, average, large or very large) since most of the children birth weights were never reported. Children who were of average size at birth had a 0.83 percent lower probability of facing deaths as compared to infants who were of small sizes at birth. Mothers should be educated on the aspect of having good nutrition during pregnancy as this determines children's birthweight (Rosenzweig and Schultz, 1983). This finding is similar to that of Elhamadi (2008).

CHAPTER 5: CONCLUSIONS

5.1 Introduction

This chapter presents summary, draws conclusions and offers some policy recommendations. It also covers research limitation and a further suggestion for future research.

5.2 Summary

Household level data from the 2014/15 Kenya Demographic and Health Survey was used and logit regression model applied to estimate independent effect of maternal, demographic, social-economic, and environmental variables on child mortality in Kenya. A number of key findings emerge from the study: dwelling in the rural areas, having mothers with no education (no schooling and poor living conditions are significantly risky factors associated with child mortality.

Mortality rates were found to be highest in Nyanza region (10.5%) and lowest in the North Eastern region (4.8%). The probability of a child born in the urban area dying was higher (0.078) compared to that born in the rural area which was 0.068).Poor households had high risks of child deaths compared to the middle household category. Household's wealth is important in determining living standards. For example, access to better sanitation and the ability to pay for hospital visits. Hence improving household's wealth increases the chances of child survival.

The minimum child bearing age among women is 15 years. An increase in the age of the mother by one year reduced the probability of infant death by 0.1 percent considering

mothers education while these effect varied to 0.3 percent increase in child's mortality when mother's education was excluded in the model. This shows that mother's age at the time of giving birth is a key determinant of child health and it should be well controlled by education. This is because as age increases lower probability of child death is experienced.

More than half (51.2%) of women who had less than three children below five years old age had lower probability of child death as compared to mothers who had more than three children. This can be as a result of the fact that households with more than 2 children do face challenges in terms of finances, nutrition and generally proper care of the children. This can be worsened by poverty where majority of households are not able to afford the basic needs.

Mother's with higher education had a lower risk to child mortality as opposed to mothers with no education. Thus education is vital to ensuring that the women are knowledgeable in child's health. This includes knowledge in prenatal and post-natal visits during and after pregnancy which are important determinants of child's survival.

Most religious institutions offer free education through seminars which help advance knowledge. In addition, some institutions do offer incentives that empower their living standards and as such mothers associated with religion are found to have lower child mortality rates.

Averagely–sized babies at birth had a 0.83 percent lower probability of infant deaths as compared to small-sized babies at birth. This can be attributed to increased health

knowledge obtained through learning that has ensured that pregnant mothers have exercise and practice healthy nutritional intake. Birth weight can be a good measure of child's health status and nutrition at birth (Rosenzweig and Schultz, 1983)

5.3 Policy recommendations

Women are encouraged to bear children during the mid-years. The reason being mortality was noted to be high among very young mothers (below 20years) and older women (above 40years). Hence, mother's age at birth is important in determining child's survival.

The study recommends that stakeholders come up with programs that assist women get financial empowerment especially in the rural areas since poverty was also a great determinant of child mortality. For instance, commercial farming can be encouraged through infrastructure development; diversifying and opening markets for the farm produce, offering affordable credit facilities to farmers, subsidizing farm inputs and educating farmers by the government.

Mothers are advised to have appropriate birth spacing (> 2years) as this will also ensure they have enough time to take care of the children and meet other obligations. This can be achieved through extensive education on family planning and making the family planning services accessible and affordable to all especially in rural areas.

Healthy lifestyle for pregnant women should be encouraged to ensure they do take good care of factors that could contribute to children's birth weight. This requires education and knowledge in the areas of nutrition and exercise during pregnancy. Poor nutrition as noted by Mwabu 2008 during pregnancy can lead to pre-term births or to children being born with low birth weight.

Finally we recommend that the government should incorporate maternal and child health education in our learning institutions curriculum to ensure improvement in health knowledge. This will increase access to knowledge. In addition, the study further recommend that women be motivated to join religious organizations as they would benefit from the knowledge that will in turn improve their children's survival.

5.4 Limitations of the study

The major limitation was KDHS 2014 data had missing variable values; for instance due to recall problem and misplaced birth records over 50 percent of women interviewed indicated their infants were not weighed at birth. This prompted use of infant birth size as a proxy for birth weight which suffered in terms of biased judgment.

5.5 Suggestions for further study

Mosley and Chen (1984) states five proximate factors that are associate with child mortality, maternal factors, environmental factors, personal illness control, nutrient deficiency and injury causes. The first four factors have been fully studied in Kenya. The last, injury causes have not been studied in Kenya; this can be attributed to data

challenges. There is need to carry a study on this aspect of child mortality as it may be the source of Kenya failing to achieve the fourth MDG target.

Given changes in facilities and awareness levels daily, there is need to carry out a similar study using current data set so as to identify population segments that require strengthened programs. In addition, current data set is needed to evaluate the government intervention e.g the malezi bora strategy in its fight on child mortality.

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APPENDIX:

SAMPLE LITERATURE REVIEWED

Name	Topic and objective	Variables and data used	Estimation technique	Findings
Stephen Ogada Omolo (2014)	Socioeconomic determinants of under five mortality- case study of Nairobi, Daresalam and Kigali	Access to water Access to toilet facility Mothers age Mothers education Wealth status KDHS 2008 data set	Logistic regression model	Children from poor families were at higher risk of death Multiple births were problem to handle for the poor Children delivered in public hospitals were less likely to die compared to children born in private hospitals
Daniel Mwangi Muriithi and Dennis K Muriithi (2015)	Determinants of infant and child mortality in Kenya using cox-proportional hazard model	Maternal education Wealth index Maternal occupation Childs birth order Maternal age Childs sex Birth size Place of delivery Source of water Type of toilet facility Place of residence KDHS 2008 data set	Cox-proportional hazard model	Children born to mothers who are sales agents have a higher risk of death compared to children born to mothers who are teachers or managers. Children born in North eastern and Nyanza region have higher mortality risks. Children born at private hospitals hae lower risk of infant mortality than those born in public hospitals.
J.n Hobcraft, J.W McDonald and SO Rutstein (1985)	Demographic determinants of infant and early child mortality; a comparative analysis	Childs sex Birth order Mothers age Birth spacing	Log linear regression model	Education reduces risk of childhood mortality Girls were associated with low mortality rates as compared to boys
Brals D et al(2013)	Description of maternal and child health in Rural Kenya	In depth survey on maternal and child health Hospital deliveries	Cox-proportional hazard model	Hospital deliveries increased with a given increase in income in Nigeria and Tanzania and surprisingly decrease with incomes in Kenya.

				Hospital deliveries increases with increased educational level of an expectant mother and her spouse
Kaldewei and Piterlle 2011	Behavioural factors as emerging main determinants of child mortality in middle income countries; case study of Jordan	Birth weight Childs gender Mothers Smoking Age of the mother	Logit estimation	Infant mortality is high if the mother smokes Elderly and very young mothers are associated with high child mortality Behavioural factors, birth spacing, smoking and breast feeding are more important in determining child mortality
Bello and Joseph (2014)	Determinants of child mortality in Oyo state Nigeria	Breast feeding Wealth status Birth weight	Logistic regression model	Poverty, malaria and breast feeding are the major determinants of child mortality
Uddin, Hossain and Ullah 2009	Child mortality in developing country: a statistical analysis	Maternal education Mothers occupation Religion Family size Birth order	Multiple logistic regression model	Fathers whose occupation was agriculture had higher mortality risks compared to fathers who were service holders